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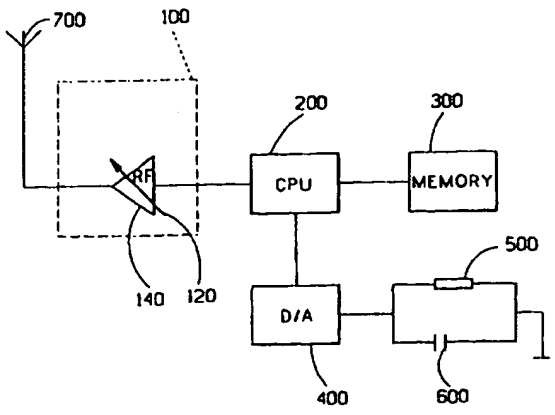
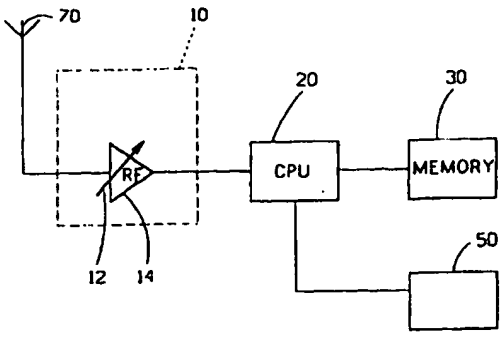
With amended claims.

(54) Title: TRANSMITTER-RECEIVER PAIR

(57) Abstract

An arrangement and a method for establishing a transmitter-receiver pair in which a transmitter (100) is provided with a first means (140) for transmitting information and in which one or more receivers (10) are provided with a receiver memory (30) and a second means (14) for receiving information. The transmitter (100) and one of the receivers (10) are placed in such close proximity to each other that information which is transmitted by the transmitter (100) via a radio communication link in one instance is received by substantially only the receiver (10) which is closest to the transmitter (100). This can be achieved by regulating the sensitivity in the receiver by a third means (12) and regulating the power of the transmitter by means of a fourth means (120) to the radio communication link.





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TITLE:

Transmitter-receiver-pair

TECHNICAL FIELD:

The present invention relates to an arrangement and a method for establishing a transmitter-receiver-pair.

BACKGROUND OF THE INVENTION:

A transmitter-receiver-pair can for example be attained by a transmitter that can transmit information and a receiver which can receive information from the transmitter. The transmitter and the receiver can for example communicate wirelessly, for example via IR, radio waves or the like, though they can in certain cases communicate via a galvanic connection, for example via a cable. When it is desired to establish a communication link between a pair and, at the same time, achieve a secure initiation, this can for example be achieved by providing the transmitter and the receiver with unique information, such as a code. However, a number of problems may arise when establishing a communication link when a plurality of receivers inter-communicate since the transmitter can inadvertently transmit the same code to a receiver with which it is not intended to establish a pair.

The different applications which can be of interest are for example wireless telephone systems, remote controls and the like. Even from a logistic point of view, it can be of interest to utilise a system in which A and B units are treated as separate units and not as a pair, since different units sometimes share the same manufacturing code which is allocated to the units during production. In the event that an allocation of a manufacturing code takes place during the manufacturing, the various units create pairs which must be treated as new units from the finally finish product to packaging, storage, retail, reparation

and exchange of the product in question. It can therefore be desirable to be able to treat the different units as separate units all the way up to retail of the product and thereby avoid the need to pair together the units during the actual manufacturing. In this manner, it becomes easier to store, repair and exchange the different units. For example, no spares store will be needed since the product store and the spares store will be the same store. Furthermore, an end user can, in a secure manner, get two arbitrary A and B units to form a pair and, accordingly, the manufacturer can save time by not having to provide these units with manufacturing codes during the manufacturing.

In terms of wireless telephone systems, these can sometimes comprise a plurality of transmitter and receiver units. It can therefore be difficult to distinguish between the various receiver units when these are connected to different subscriptions since a transmitter (which has not been associated with a particular receiver) can reach a receiver with a subscription which does not belong to the user. In order to overcome this problem, it may be suitable to provide the transmitter and the receiver with a common code. This can be achieved for example by the transmitter generating a code and transmitting the code to the intended receiver (or vice versa). However, the problem of being able to distinguish between the various receiver units remains when these are close together, since the code which the transmitter generates and transmits to the intended receiver can also be received by other receivers than the intended one. It is therefore desirable to be able to achieve a secure initiation of a code between a transmitter and a receiver.

A method is described in US-A-4,529,980 for providing a multi-channel transmitter and receiver able to control a

plurality of functions in a remote control. The transmitter and the receiver communicate with each other via both a radio communication link as well as infrared diodes (IR-diodes). The radio communication link is used to control the functions with which the receiver is equipped, whilst the diodes serve to transmit identity codes intended for various functions of the remote control from the receiver to the transmitter. One object of US-A-4,529,980 is to provide the transmitter and receiver with a large number of codes in order to eliminate possible mix-up between transmitter and receiver systems which are in close proximity to each other. This can be achieved by the receiver generating a random identification code which is then transmitted to the transmitter via an IR-diode. The transmitter and the receiver are placed in close proximity to each other, i.e. the light from the light diode of the receiver is directed towards the diode of the transmitter, without interfering with other transmitter and receiver systems.

However, it would appear that the system requires two different sender and two different transmitter and receiver systems, i.e. a radio link and infrared diodes (IR-diodes), in order to be able to eliminate mix-up between transmitter and receiver systems which are in close proximity to each other. This can be a considerable disadvantage since additional costs can arise and the system becomes more complicated since two transmitter and receiver systems are used instead of just one. In addition, the system becomes dependent on how the transmitter and receiver are oriented when a new code is to be initiated. A further drawback can arise when the system is intended to be used in direct sunlight or in certain types of industrial environment in which a great deal of IR-light is present (for example in welding shops). In such cases, complicated and expensive

filters are often needed in order to filter out undesirable light.

SUMMARY OF THE INVENTION:

It is therefore an object of the present invention to provide an arrangement and a method for establishing a secure initiation of a transmitter-receiver-pair, i.e. an initiation which can only be received by the receiver which is positioned closest to the transmitter.

A further object of the present invention is to provide an arrangement and a method for establishing a transmitter-receiver-pair which is insensitive to orientation, i.e. establishing of a pair is effective irrespective of the orientation of the transmitter or the receiver.

An additional object of the present invention is to provide an arrangement and a method for establishing a transmitter-receiver-pair in a simple manner and at low cost.

Yet another object is to provide an arrangement and a method to reduce/save storage space during manufacturing, storage, retail and service/exchange of transmitter and receiver systems.

In accordance with the present invention, the above-mentioned objects are achieved by the provision of a method and an arrangement for establishing a transmitter-receiver-pair in which a transmitter is provided with a first means for transmitting information and in which one or more receivers are provided with a receiver memory, and in second means for receiving information. The transmitter and one of the receivers can be arranged so close to each other that information which is transmitted by the transmitter via a radio communication link in one instance is received by substantially only the receiver which is closest to the

transmitter, by means of a third means which regulates the sensitivity of the receiver and/or by means of a fourth means which regulates the power of the transmitter to the radio communication link.

BRIEF DESCRIPTION OF THE DRAWINGS:

The invention will be become more apparent from the following description of a preferred embodiment shown by way of example and with reference to the attached drawings in which:

Fig. 1 shows a block diagram of a transmitter-receiver-pair in accordance with the present invention, and

Fig. 2 shows a flow diagram of a method according to the present invention

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS:

With reference to Fig. 1a and 1b, an embodiment of an arrangement for establishing a transmitter-receiver-pair in accordance with the present invention is shown. The arrangement can for example be constituted by a transmitter (which is shown in Fig. 1a) and one or more receivers (as shown in Fig. 1b). The transmitter can for example be provided with a first means for transmitting information 100 and each receiver can be provided with a receiver memory 30 and a second means for receiving information 10. The transmitter and/or the receiver can also be provided with an aerial 700,70.

The output power of the transmitter and/or the sensitivity of a receiver should be so high (or so low) that the receiver can receive the information which the transmitter intends to transmit, though not so high that a second receiver, rather than the intended receiver, can possibly

receive the same information from the transmitter. In order to eliminate this risk, the transmitter and the receiver which is intended to receive the information from the transmitter can be arranged in such close proximity to each other that information that is transmitted by the transmitter, for example via a radio communication link, in one instance is received by substantially only the receiver which is closest to the transmitter. In order to establish a suitable sensitivity, a third means 12 can be provided to regulate the sensitivity of the receiver. A suitable level of power can be attained via a forth means 120 which regulates the power of the transmitter in said radio communication link.

The first means 100 which is used to transmit information can for example be in a form of a transmitter 140 which preferably transmits information in the form of radio waves and also microwaves, for example within 100 MHz to 3 GHz and sometimes even higher, preferably between 400 MHz to 2.5 GHz and more preferably about 433.92 MHz or 2.45 GHz. This therefore implies that wavelengths at 3 GHz are about 0.1 m and at 100 MHz about 3 m. In order achieve a secure initiation, i.e. that information from the transmitter will be received by the intended receiver, a distance which should correspond to about half the wavelength or less is suitable. In the case in which the frequencies can have values between 100 MHz and 3 GHz, a distance of between 1.5 m to 0.05 m can be suitable. How the actual transmission is achieved is well known and will not therefore be described in greater detail. Naturally IR-diodes can also be used, but in such case, the transmitter will be directionally dependent.

The second means 10 which is used to receive information can for example be in the form of a receiver 140 which preferably receives information in the form of radio waves.

How this is achieved is well known and will not therefore be described in greater detail.

The third means 12 which is used to regulate the sensitivity of the receiver can for example be in the form of a potentiometer which for example is positioned in the feedback to one or more preamplifiers in the receiver 10. The potentiometer can for example be in the form of a variable resister (such as a JFET, MOSFET or another similar transistor). Another method for regulating the sensitivity can be for example by changing the working point for the amplifier step/steps. Naturally, other types of potentiometers can by used such as carbon film or similar.

In order to be able to determine the distance, the field strength between the transmitter and receiver is measured. By measuring the field strength close by (the near field), the distance dependency of the field strength can be used, typically between the second and third order of the distance. This implies that a small change in distance results in a large difference in the field strength, whereby a high reliability can be attained against activating distant units and/or a distant unit approves a signal from the transmitter, due to the field strength varying faster with the distance in the near field than in the far field. Thus, reflected signals from the surroundings, i.e. from the far field, will be so weak that they can be neglected. One example of the distances which the system in this embodiment can operate within can be between 1-100 cm, preferably between 7-35 cm, with distances of about 0.1-0.5 λ which generally correspond to the 433.92 MHz band.

According to the invention the field strength is measured by a fifth means (not shown), which is arranged in the

receiver, comprising a unit for measuring the field strength close by, in order to increase the distance-dependency between the transmitter and the receiver. The fifth means can for example be constituted by a signal strength meter, like a RSSI-circuit (Received Signal Strength Indicator), in which the signal strength will constitute a measure of the field strength. The amplification in the fifth means can be adjusted through a higher-ranked system, which in this case can be constituted by a microprocessor 20 and/or the third means 12 in order to regulate the sensitivity. The requirement on the higer-ranked system is that the amplification can be adjusted downward so far that the block which measures the field strength reaches an operating range belonging to its normal range. The normal range in this case varies within a couple of decimeters down to a couple of centimeters. Due to the fact that the higher-ranked system can be constituted by the microprocessor 20 it is possible to produce a reduction of the amplification completely automatically, e.g. by a detector. This detector can for example be constituted by an amplitude detector, which can provide a direct measure of the field strength, or an AGC-circuit (Automatic Gain Control) which can provide a indirect measure of the field strength.

The fourth means 120 which is used to regulate the power of the transmitter can be for example in the form of a potentiometer which may be placed in the feedback to one or more final stages in the transmitter 100. The potentiometer can for example be in form of an adjustable resister (for example a JFET, MOSFET or similar transistor). A further method for regulating the sensitivity can be by changing the working point for the amplifier step or steps. Of course, other types of potentiometers can be used, such as carbon film or the like.

The transmitter may also be provided with a random generator, for example to generate information (a unique code) which is intended to be transmitted to the receiver and thereby increase the possibility that only one receiver receives this information. This information can for example be in form of a code which is unique for both the transmitter and the receiver. In order for the transmitter to be able to know what information has been sent to the receiver, the transmitter can be provided with a transmitter memory 300. Instead of using a random generator, a user can for example manually input a code to the transmitter, for example via a keyboard which can be connected to the transmitter. Yet another variation can be that the code in the transmitter is fixed and determined by the manufacturer (this code may come from a random generator or a consecutive sequence, (for example a serial number).

The random generator which is used to generate the information which is intended to be sent to the receiver can for example be arranged within a microprocessor 200 which is connected to the transmitter 100. The microprocessor 200 in the transmitter can be further connected to one or more transmitter units which are intended to be controlled, for example via a D/A-converter 400.

The transmitter units can be in the form of a head-set consisting of a loud speaker 500 and a microphone 600 which for example can be part of a wireless telephone system. The head-set can be further provided with a receiver, for example one which corresponds to the receiver which has been described earlier, to receive speech and other signals via a radio communication link. In the same manner, the receiver can be provided with a transmitter in order to be able to establish a two-way communication. Rather than a head-set, another example can for example be a remote

control system in which the transmitter unit can be the actual control, for example that which controls the various functions in the system.

As with the transmitter, the receiver can also be provided with a microprocessor 20, whereby the microprocessor 20 in the receiver can be connected to one or more receiver units 50 which are intended to be controlled, for example via a suitable interface (not shown). The receiver units can furthermore be provided with connections to respective telephone subscriptions and a transmitter for establishing a two-way communication between the transmitter and receiver units.

The receiver memory 30 and the transmitter memory 300 can be example be in the form of electronic memories, for example RAM or the like.

In order to facilitate the adjustment of the output power of the transmitter and/or the sensitivity of the receiver, the receiver may be provided with an indicator (not shown) for the received signal strength. This indicator can for example be in form an of RSSI-indicator (Receiver Signal Strength Indicator).

The system may further be complemented with an active verification that only one receiver is within range. Those receiver units which accept the signal strength (for example by an RSSI-indicator and a transmitter) thus actively provide a confirmation of this to the transmitter. In the case that the transmitter unit detects (for example via a receiver) more than one receiver unit, the user can be thus informed so that this can be dealt with.

Further fields of use can be within logistics where it may be of interest to use receiver-transmitter systems since

various units must sometimes share the same manufacturing code which can be allocated to the units upon retail of a product. In this manner, it is therefore possible to treat the different units as separate units up to the moment of retail of the product and thereby avoid having to pair together the units after the actual manufacturing. In this manner, it becomes easier to store, repair and exchange the different units. For example, no spares store is required since the product store and the spares store are the same.

A method according to the present invention will now be described with reference to Fig. 2 where A can function as a master unit and B can function as a slave unit. Upon starting the A-unit, this will activate a transmitter, possibly with reduced power, so that the B-unit is able to find the A-unit, i.e. the B-unit listens for activity. Should the B-unit not find the A-unit, B will continuously seek A. Once the B-unit has found the A-unit, B measures the signal to check that the signal strength is above a certain threshold value. Should the threshold value not be sufficiently high, B will recommence listening for activity, otherwise B signals to A that the B-unit is present. During the time that B is measuring the signal, the A-unit waits (i.e. B "not present") for the signalling from B. Once A has received a signal from B, the A-unit transmits information to the B-unit, for example in the form of a code, in this phase B initiates code receival. During the actual initiation, the B-unit checks once more that the signal strength is sufficient. If it is not, B recommences listening for activity. Should the signal strength be sufficient, B will check that the code has been received. If it has not been received, the B-unit checks once more that the signal strength is sufficient. Once the code has been received, B can send a receipt to A and thereafter wait for A to turn off its transmitter. When A has received a receipt from B, A will check the code that

it is accepted. Should the code not be accepted, A waits a certain period and resends a code to B, which can be repeated for a restricted number of attempts ("Maximum number of attempts"). Once the maximum number of attempts has been attained, the A-unit will regard this as a failed transmission and the method is terminated. Should the code be accepted, the A-unit will turn off the transmitter, B detects this and the transmission is attained. At the same time, the B-unit will turn off its transmitter and store the code.

Although the shown embodiments of the present invention have been described in detail with reference to the attached drawings, it is to be appreciated that the invention is not restricted to these specific embodiments and that various changes or modifications can be made by a skilled person without departing from the scope of protection which is defined by the appended claims. For example, the receiver can generate the information (code) which is attained by the transmitter and retransmit this to the transmitter.

CLAIMS:

1. Arrangement for establishing a transmitter-receiver pair in which a transmitter (100) is provided with a first means (140) for transmitting information and in which one or more receivers (10) are provided with a receiver memory (30) and a second means (14) for receiving information, wherein said transmitter (100) and one of said receivers (10) are arranged in such close proximity to each other that information which is transmitted by the transmitter (100) via a radio communication link in one instance is received by substantially only the receiver (10) which is closest to the transmitter (100), c h a r a c t e r i z e d i n that said receiver is provided with means for measuring the field strength close by, in order to increase the distance-dependency of the field strength between transmitter and receiver.

2. An arrangement according to claim 1, c h a r a c t e r i z e d i n that said transmitter is provided with a random generator for generating said information.

3. An arrangement according to claim 1 or 2, c h a r a c t e r i z e d i n that said transmitter is provided with a transmitter memory (300).

4. An arrangement according to claim 1, 2 or 3, c h a r a c t e r i z e d i n that said transmitter and/or receiver are provided with an aerial (70, 700).

5. An arrangement according to any one of the previous claims, c h a r a c t e r i z e d i n that said receivers are provided with an indicator for the received signal strength.

6. Method for establishing a transmitter-receiver pair in which a transmitter (100) is provided with a first means (140) for transmitting information and in which one or more receivers (10) are provided with a receiver memory (30) and a second means (14) for receiving information, wherein said transmitter (100) and one of said receivers (10) are placed in such close proximity that information which is transmitted by the transmitter (100) via a radio communication link in one instance is received by substantially only the receiver (10) which is closest to the transmitter (100) c h a r a c t e r i z e d i n that said receiver measures the field strength close by, in order to increase the distance-dependency of the field strength between transmitter and receiver.

7. A method according to claim 6, c h a r a c t e r i z e d i n that said transmitter generates said information via a random generator.

8. A method according to any one of claims 6-8, c h a r a c t e r i z e d i n that an indicator indicates the received signal strength in said receiver.

AMENDED CLAIMS

[received by the International Bureau on 8 December 1997 (08.12.97); original claims 1 and 6 amended; remaining claims unchanged (2 pages)]

1. Arrangement for establishing a transmitter-receiver pair in which a transmitter (100) is provided with a first means (140) for transmitting information and in which one or more receivers (10) are provided with a receiver memory (30) and a second means (14) for receiving information, wherein said transmitter (100) and one of said receivers (10) are arranged in such close proximity to each other that information which is transmitted by the transmitter (100) via a radio communication link in one instance is received by substantially only the receiver (10) which is closest to the transmitter (100), c h a r a c t e r i z e d i n that said receiver is provided with means for measuring the field strength in the near field, in order to increase the distance-dependency of the field strength between transmitter and receiver.

2. An arrangement according to claim 1, c h a r a c t e r i z e d i n that said transmitter is provided with a random generator for generating said information.

3. An arrangement according to claim 1 or 2, c h a r a c t e r i z e d i n that said transmitter is provided with a transmitter memory (300).

4. An arrangement according to claim 1, 2 or 3, c h a r a c t e r i z e d i n that said transmitter and/or receiver are provided with an aerial (70, 700).

5. An arrangement according to any one of the previous claims, c h a r a c t e r i z e d i n that said receivers are provided with an indicator for the received signal strength.

6. Method for establishing a transmitter-receiver pair in which a transmitter (100) is provided with a first means (140) for transmitting information and in which one or more receivers (10) are provided with a receiver memory (30) and a second means (14) for receiving information, wherein said transmitter (100) and one of said receivers (10) are placed in such close proximity that information which is transmitted by the transmitter (100) via a radio communication link in one instance is received by substantially only the receiver (10) which is closest to the transmitter (100) c h a r a c t e r i z e d i n that said receiver measures the field strength in the near field, in order to increase the distance-dependency of the field strength between transmitter and receiver.

7. A method according to claim 6, c h a r a c t e r i z e d i n that said transmitter generates said information via a random generator.

8. A method according to any one of claims 6-8, c h a r a c t e r i z e d i n that an indicator indicates the received signal strength in said receiver.

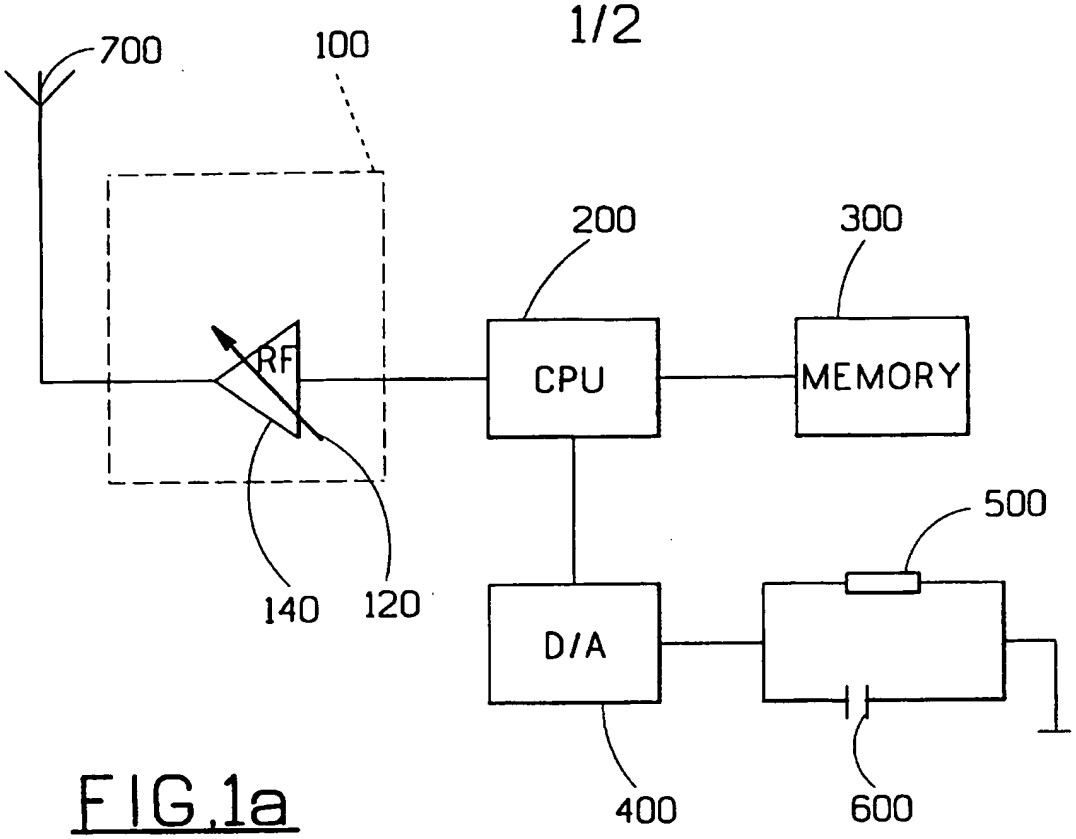
700
100
200
300
RF
CPU
MEMORY
500
140
120
D/A
400
600

FIG.1a

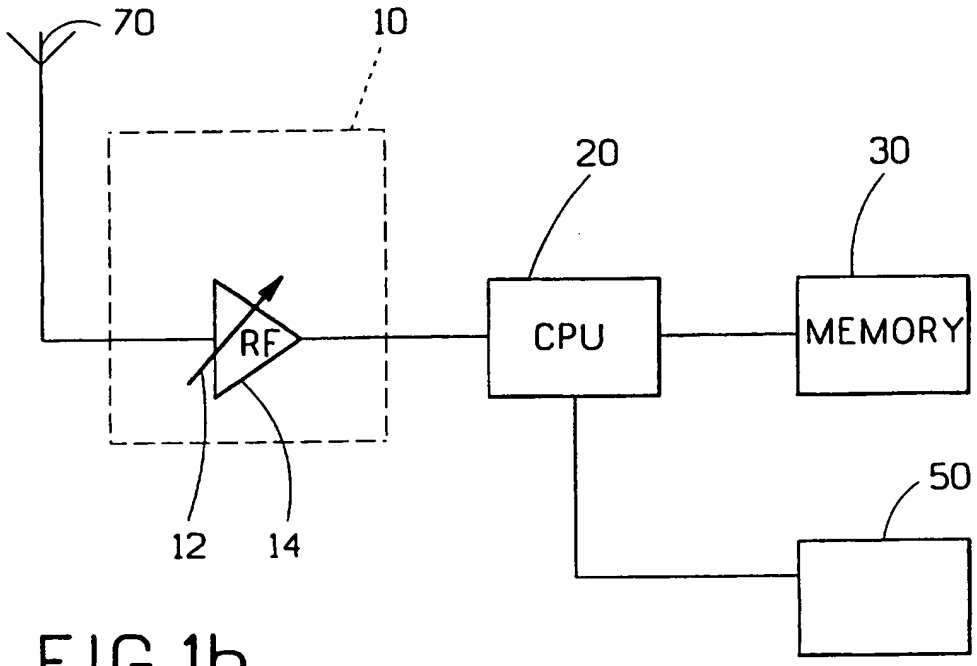
70
10
20
30
RF
CPU
MEMORY
50
12
14

FIG.1b

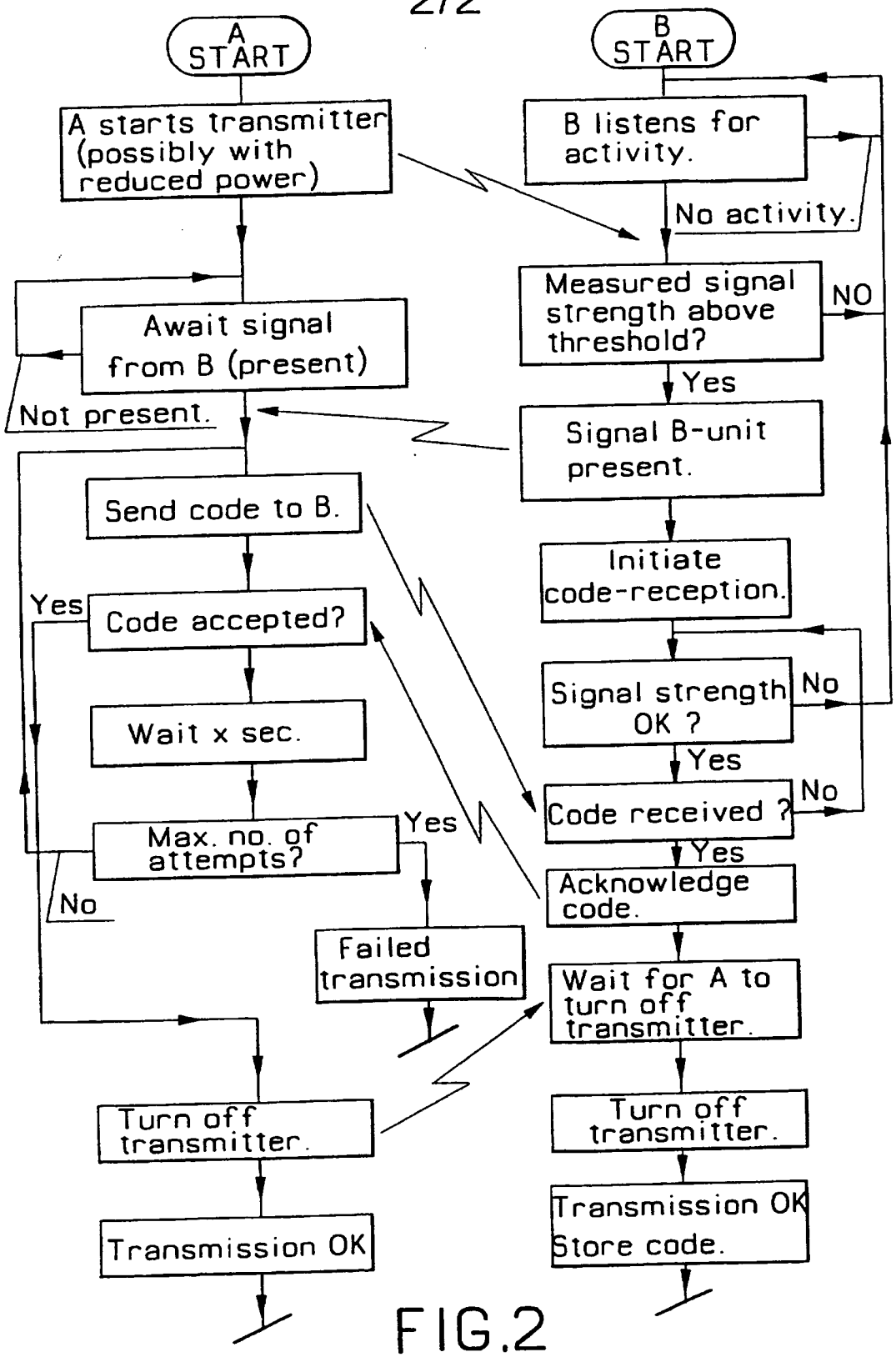
A START
A starts transmitter (possibly with reduced power)
Await signal from B (present)
Not present.
Send code to B.
Yes
Code accepted?
Wait x sec.
Max. no. of attempts?
Yes
No
Failed transmission
Turn off transmitter.
Transmission OK
B START
B listens for activity.
No activity.
Measured signal strength above threshold?
NO
Yes
Signal B-unit present.
Initiate code-reception.
Signal strength OK ?
No
Yes
Code received ?
No
Yes
Acknowledge code.
Wait for A to turn off transmitter.
Turn off transmitter.
Transmission OK
Store code.

FIG.2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01214

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G08C 17/02, H04M 1/72
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G08C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 9606499 A2 (PHILIPS ELECTRONICS N.V.), 29 February 1996 (29.02.96), page 4, line 1 - page 5, line 2; page 3, line 9 - line 13; page 6, line 19 - line 24, figures 1,3-4, abstract --	1-8
Y	US 4988992 A (CARL T: HEITSCHEL ET AL), 29 January 1991 (29.01.91), column 3, line 60 - column 4, line 26, abstract --	2,7
Y	US 4825200 A (BENJAMIN F. EVANS ET AL), 25 April 1989 (25.04.89), column 5, line 4 - line 16; column 2, line 27 - line 37; column 3, line 12 - line 16, figure 2, abstract, column 6, line 34 - line 38. --	1-8

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 November 1997	20 -11- 1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Roland Landström Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
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